The MassGIS Protected and Recreational OpenSpace GeoDatabase Data Model – Phase I

INTRODUCTION

MassGIS OpenSpace started around 1988 with the digitization of USGS Topo sheets. Many of these original features are still in OpenSpace (arc_date = 1901).

MassGIS has been moving its data storage system to ArcSDE for some time now. This move was necessitated by the increased performance of ESRI's GIS products using SDE with a 3rd party RDBMS (Oracle 8i, in our case) over LIBRARIAN. Currently, all our static datasets have been moved to SDE from LIBRARIAN except for data that is still actively edited. These data are troublesome in that their fundamental data structure and self-referential integrity are altered. The basic data structure for LIBRARIAN is ESRI's "coverage" model, while SDE's basic data structure is the "shapefile" model, albeit with the additional functionality of the Geo-Database. The two most noticeable differences moving from the former to the latter are the loss of topology and the inability to tie spatially related feature classes together into one entity — a coverage. This difference has a profound effect on the MassGIS Protected and Recreation Open Space Datalayer (hereafter referred to as OpenSpace).

Name	Type
annotation.os_id	Annotation Feature Class
annotation.owner	Annotation Feature Class
annotation.site	Annotation Feature Class
arc	Arc Feature Class
label	Label Feature Class
polygon	Polygon Feature Class
region.regsite	Region Feature Class
tic	Tic Feature Class

Coverage Data Structure

The coverage model of OpenSpace is not a single feature class, but a related set consisting of tics, labels, arcs, polys, regions and several levels of annotation. Attribute data is stored in the INFO table <cover>.PAT and is in a simple "flat-file" format (Meaning that the data is not stored in a related set of tables, but a single table of rows and columns. Due to the nature of OpenSpace, this leads to excessive amounts of "white-space" and redundancy). This is inefficient in storage and query speed compared to such functionality found in modern RDBMS software (e.g. Oracle), especially in high volume environments (e.g. multi-user environments or web services).

The complex relationships inherent within the OpenSpace coverage do not translate easily to a simple shapefile model. This is especially true for the editing workflow. Moving from the coverage data model to the shapefile data model, the constituent features of the OpenSpace coverage must be translated into independent shapefile feature classes, each representing a feature class within the coverage (arcs, polygons and regions; anno, tics, and labels are lost in our cov2shp conversion). The nature of shapefiles leaves us with no easily enforceable interrelationship between these feature classes such as that inherent in coverage topology. Since much effort has been spent over the last 15 years to maintain topological integrity in our OpenSpace data, we have continued to edit in the coverage environment of Workstation ArcInfo.

With the advent of ArcGIS 8.0, ESRI introduced a new data structure for GIS, namely the GeoDatabase. It was intended to eventually replace the coverage as the "workhorse" data structure for most ESRI products and was designed to have no practical limits to data size for storage (when implemented with ArcSDE), display (only fetches data relevant to the current view), or analysis (handles processing of large datasets). A few caveats to this have surfaced since the introduction of ArcGIS 8.0 and have been improved upon by ESRI in subsequent releases. The ArcGIS 8.3 release introduced "rules-based topology" — a feature required for the migration of OpenSpace to a GeoDatabase and a complete renovation of the way topology is implemented and maintained (*Hoel, Menon and Moorehouse*, 2003). At this time, the current release is ArcGIS 9.0, which promises to yield many more improvements, especially in GeoProcessing. At ArcGIS 9.0, the desktop product is no longer tied to the workstation product for functionality. The release of ArcSDE 9.0 also promises to provide improvement of data access speeds and on-the-fly database compression (No longer need to kick all SDE users off or reconcile/post all versions anymore).

Name	Type
osp1a1.shp	Shapefile
osp1g1.shp	Shapefile
osp1p1.shp	Shapefile

Shapefile Data Structure

Coverage topology behavior can be modeled in a geodatabase by a combination of rules.

The "rules-based" topology of Arc GIS 8.3/9.0 is very different from the "forced" topology of ArcInfo 7 and earlier. To take full advantage of the GeoDatabase, the OpenSpace data structure has had to be completely overhauled. The new model uses custom GeoDatabase features, a fully relational set of tables to better model OpenSpace, custom tools for editing and analysis in ArcMap, better modeling of complex ownership/interest issues concerning real property and maintains feature topology. This provides an

opportunity for dramatic improvement to our data structure and should serve OpenSpace in Massachusetts well for years to come.

Due to the fact that this is such a large change in the structure of OpenSpace, we will implement it in two phases. Phase I consists of moving the "flat-file" model to ArcSDE. The first step involves a major cleaning of the dataset (fixing typos, etc.). OpenSpace will then be split into 3 feature classes; OPENSPACE_ARC, OPENSPACE_POLY, and CHAPTER61_POLY that will all participate in a single topology, mimicking the spatial integrity of a single coverage. Several new fields will also be added and defunct fields will be dropped. Phase I will require the development of new QA/QC tools using the ArcObjects environment and some python scripting. These tools include a new data entry form, a versioned ID tool and DBA assessment tools. Phase II involves taking the last step of breaking the "flat" model into the fully relational model. The toughest part of this transition is insuring that all relationships model existing data properly. The current plan is to implement Phase I in the Summer of 2004 and Phase II in the Fall/Winter of 2004.

PHASE I
Coverage into flat SDE geodatabase

PHASE II
Flat model into relational tables

CONCEPT – MOVING FROM COVERAGE TO GEODATABASE

The first step was to examine the existing coverage data model and determine what should be kept, what should be dropped and what should be added. Looking at the feature classes involved in the coverage, and knowing that the labeling engine in ArcGIS is relatively robust, it was clear that the annotation layers could be dropped along with the regions (on site name) that existed only for the purpose of clearly labeling sites comprised of multiple parcels. The coverage annotation has become somewhat corrupt and does not appear worth the effort to migrate. In ArcGIS 9 we will be able to implement feature-linked annotation that will become the standard for OpenSpace in the future. This left us with labels, arcs and polygons. Without hard-wired coverage topology, the label attributes can be incorporated into the new polygon feature class. The arc feature class contains the very useful but oft ignored "code" field that has not been maintained very well over the years. Although this information could be dropped as the corresponding line segments of the polygons get snapped, it was determined that there was value to be had in retaining the arc feature class as an element to combine with the polygon feature class using a shared topology in a feature dataset. The arc layer is modified to now retain a history of source data and edits for each line segment (node to node). This will allow better estimation of the spatial quality of any given polygon in the new model.

The use of field domains will simplify editing and data maintenance.

An important feature of GeoDatabase technology is the ability to easily make attribute domains for simplified editing and constraining entered attributes for some fields. This will be apparent to the editor as drop down lists of valid attributes and validation of attributes. The domains provide a database enforced constraint upon what values may be entered into associated fields. ArcGIS will not allow the editor to enter data that falls out of the pre-defined domain bounds.

OSNAMES was the INFO table used in the coverage model to record all abbreviations used as OpenSpace field values. It was neglected for several years and subsequently many abbreviations were erroneously introduced into OpenSpace.

The biggest change though, is the breaking up of the coverage model into several related feature classes. Chapter 61 lands are now an individual feature class, similar to but different from other OpenSpace. Along with dropping some no longer needed fields, many new fields were added to better model land ownership and separated rights in land in Massachusetts. Arcs are now modeled as a separate feature class to allow tracking of individual arc edits/sources. These three feature classes are tied together by a set of topology rules describing their defined spatial correlation. The OSNAMES table has also been explicitly incorporated into SDE to allow for better attribute coding via the custom OpenSpace edit form. The full description of the new attributes and tables follows.

THE NEW MODEL – PHASE I

Taking the existing PAT and AAT, the overall usefulness of the current model was evaluated and altered on paper through a series of meetings and discussions with OpenSpace editors. There are a few steps to complete before altering the data structure.

Data Preparation:

The first step is getting the 351 LIBRARIAN coverage tiles into a single statewide coverage. This step proved to be difficult as the resulting coverage could not be built due to intersection errors at town boundaries. Years of clipping coverage tiles to the town bounds had presumably resulted in a bit of rounding error (the data was single precision) and thus the tiles didn't fit anymore. To fix all these errors (many thousand) would take a long time of protracted editing. It was then decided to move the errors along into SDE and take advantage of versioned editing and rules-based topology in an SDE GeoDatabase. First, we could construct polygons from the old OpenSpace arcs and labelpoints in SDE regardless of the poor topology. Since all OpenSpace polygons were complete and closed, the only errors are from overlaps between tiles thus ensuring that every polygon gets moved into the GeoDatabase. Arc8 topology was then generated on top of the data to find these intersections and overlaps. These will be fixed over time by the DBA whilst editors can continue to add new data in the versioned environment of SDE — again, a nice feature of a versioned GeoDatabase.

The next step is the most arduous — cleaning the attribute data. This makes use of the frequency command (available for a GeoDatabase at Arc9) to find all instances within a field value. The results are then sorted and cleaned up in the statewide dataset. Not an easy task, but unlike the topology, this cannot be put on the versioned back-burner — we plan to use the data itself in the new editing form (self-validation!) so it must be clean for everything to work properly.

The INFO table, OSNAMES has been cleaned up and expanded for use in the new edit form. This will be used as a self-referential lookup table for the various interest fields.

Commonwealth/EOEA interests have been cleaned up for use with the new edit tools and for proper symbolization on the FEESYM & INTSYM fields.

At present, no aliases have been established for OpenSpace analogous to the Alternate Name option for coverages.

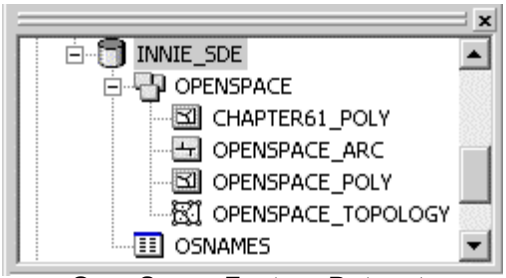
Non-Profit interests will be broken into three categories: Non-Profits (Type='N'), Land Trusts (Type='L') and Conservation Non-Profits (Type='G'). The land trust values will be taken from the Massachusetts Association of Land Trusts listing available at http://www.massland.org/pages/neartrust/mainlist.html (Actually, there are a few more land trusts not affiliated with MassLand included in OpenSpace that will be coded 'L').

Actual holdings that are covered with water must be reassessed. Previously, this was coded as SFO = 'W' and only used for MDC land. It has become apparent that this is a more complex issue, not only for DCRW. Therefore, these sites will be recoded to the owner's true type and have PRIMARY_PURPOSE set to 'U' for Underwater.

Municipal interests need to be reconciled with OSNAMES and the town itself (What are the departments really called vs. what did the volunteer tell us?).

Many fixes can be done in the background by the DBA during active editing by agency OpenSpace Editors.

Before examining the new tools and use of the data further, let's look at the new data structure itself.



OpenSpace Feature Dataset

Feature Dataset

In the root level of the MassGIS SDE GeoDatabase on Innie (Sun420.env. state.ma.us) lies the new GISDATA.OPENSPACE Feature Dataset. Inside this dataset are the 3 OpenSpace Feature Classes and the Topology Feature (which is treated as separate feature class by ArcGIS). Outside of the Feature Dataset lies the OSNAMES table required for using the custom edit form (Tables cannot be included in a feature dataset).

Field	Type	Domain	Comments
TOWN_ID	SmallInteger - 3	Town_ID	Range: 1 - 351
POLY_ID	LongInteger - 5		Limited to 99999 by definition
LOC_ID	String - 15		Link to MGIS Standard parcels
DCAM_ID	LongInteger - 7		Link to DCAM field ARC_ID
FEE_OWNER	String - 100		
ABRV_FEE_OWNER	String - 20		Coded off OSNAMES_MOD
TYPE_FEE_OWNER	String - 1	OS_Type	Coded
MANAGER	String - 100		
ABRV_MANAGER	String - 20		Coded off OSNAMES_MOD
TYPE_MANAGER	String - 1	OS_Type	Coded
OTHER_1	String - 100		
ABRV_OTHER_1	String - 20		Coded off OSNAMES_MOD
INT_1	String - 20	OS_Interests	Coded
TYPE_1	String - 1	OS_Type	Coded
OTHER_2	String - 100		
ABRV_OTHER_2	String - 20		Coded off OSNAMES_MOD
INT_2	String - 20	OS_Interests	Coded
TYPE_2	String - 1	OS_Type	Coded
OTHER_3	String - 100		
ABRV_OTHER_3	String - 20		Coded off OSNAMES_MOD
INT_3	String - 20	OS_Interests	Coded
TYPE_3	String - 1	OS_Type	Coded
GRANTPROG1	String - 20	OS_Projects	Coded
GRANTTYPE1	String - 1	OS_Type	Coded
GRANTPROG2	String - 20	OS_Projects	Coded
GRANTTYPE2	String - 1	OS_Type	Coded
SITE_NAME	String - 120		
GIS_ACRES	Double - 10,4		Calc'd field
ASSESS_ACRES	Double - 10,4		
DEED_ACRES	Double - 10,4		
PROJ_ID1	String - 20		
PROJ_ID2	String - 20		
PROJ_ID3	String - 20		
FY_FUNDING	SmallInteger - 4	FiscalYear	Range: 1800-2010
CAL_DATE_REC	Date		Use Jan. 1 if only year is known
BOND_ACCT	String - 20		
PRIMARY_PURP	String - 1	OS_Prim_Purp	Coded
PUB_ACCESS	String - 1	OS_Pub_Acc	Coded
LEV_PROT	String - 1	OS_Lev_Prot	Coded
ARTICLE_97	SmallInteger - 1	Boolean	Coded: Yes/No
EOEAINVOLV	SmallInteger - 1	OS_EOEAINVOLV	Coded
OS_DEED_BOOK	LongInteger - 6		
OS_DEED_PAGE	LongInteger - 4		
ASSESS_MAP	String - 10		
ASSESS_BLK	String - 10		
ASSESS_LOT	String - 10		
ASSESS_SUBLOT	String - 10		
BASE_MAP	String - 10		
SOURCE_MAP	String - 50		Derelict field
SOURCE_TYPE	String - 10	OS_Source	Coded
COMMENTS	String - 255		
ATT_DATE	Date		Calc'd field
FEESYM	String - 20		Calc'd field
INTSYM	String - 20		Calc'd field
OS_ID	String - 9	Unique ID!	Calc'd field

OPENSPACE_POLY schema

GISDATA.OPENSPACE_POLY

This is the primary feature class for Open Space. There are several new fields as noted below and some fields that have been dropped. The table to the right is a brief description of the feature class attribute fields.

The SCORP_ID field has been deleted as it is about 15 years out-of-date. A table remains in SDE that links OS_ID to SCORP_ID if there is ever a need for that record in the future. The POLY_DATE field has been dropped – the date of last spatial alteration for a parcel now exists in the ARC feature class. This will yield finer grained spatial edit attribution. The COUNTY_CODE field has also been dropped as counties are no longer legal entities. Relic coverage fields have also been dropped (including many redefined fields).

Many of the new fields were added to resolve existing or foreseen limitations in the existing data model. In the following section is a description of each field and its intended use.

TOWN_ID — A 3 digit integer uniquely identifying every municipality in Massachusetts. This is a domained field that ranges from 1 (Abington) to 351 (Yarmouth).

POLY_ID — A 5 digit integer unique identifying every feature in the given municipality. This field needs to remain unique relative to the parcel of land rather than to ArcGIS. For this reason we do not use the ArcGIS generated OID.

LOC_ID — 12 digit number identifying the coordinates of the centroid of the parcel in MassGIS Standard Parcels.

DCAM_ID — 7 digit integer for linking to the DCAM data tables via the ARC_ID field.

FEE_OWNER — The name of the holder of the deed to the land represented in the polygon. If there is questionable/ unclear ownership, this is who pays the taxes on the property.

ABRV_FEE_OWNER — The link to the OSNAMES table. A simple and unique abbreviation for some of the lengthier names in the field.

STATUS_FEE_OWNER — Category for the fee owner's status. Domained.

MANAGER — The name of the entity that maintains the property if different from the fee owner.

ABRV_MANAGER — The link to the OSNAMES table.

STATUS_MANAGER — Category for the manager's status. Domained.

OTHER_1 — The name of the holder of the associated interest.

INT_1 — The type of interest held by OTHER_1. Domained.

ABRV_OTHER_1 — The link to the OSNAMES table. A simple and unique abbreviation for some of the lengthier names in the field.

STATUS_1 — Category for the interest holder's status. Domained.

<<2nd and 3rd interests>> — *Ibid*.

GRANTPROG1 — Grant program associated with the parcel. Domained.

GRANTSTAT1 — Category for the grant status. Domained.

<<2nd grant>> — *Ibid*.

SITE_NAME — The name associated with the parcel, if any (e.g. Jones Park).

AREA_ACRES — GIS Calculated acreage of parcel.

ASSESS_ACRES — Acreage according to the local assessor maps or database.

DEED_ACRES — Acreage according to the recorded deed.

PROJ_ID1	Project identifier for the parcel; may include many parcels under a single project (EOEA use only).
<<2nd and 3rd projects>>	*Ibid.*
FY_FUNDING	Fiscal year project was completed (EOEA use only). Domained.
CAL_DATE_REC	Calendar date deed was recorded. If only year is known, it is set to January 1st of that year.
BOND_ACCT	Funding of parcel acquisition/protection (EOEA use only).
PRIMARY_PURP	A single character text code indicating the *initial* reason the land was acquired as open space. In most cases, this is also the current use of the land, but there are some exceptions. The most frequent exception is municipal land acquired many years ago for water supply that has then been discontinued as a public water supply and converted into recreation/conservation land. Domained.
PUB_ACCESS	A single character text code indicating the *legal* level of public access (not to be confused with physical access such as street frontage). For most parcels, public access is either open (public is welcome on the parcel) or closed (no public allowed). Domained.
LEV_PROT	A single character text code indicating the relative impediment to the parcel being developed. As no parcel of land can ever be "permanently" protected, we consider many different types of land interest to impart protection in perpetuity. These include Article 97 lands (e.g. EOEA agency land), non-term Conservation Restrictions, land held by land trusts and environmental non-profits, etc. All parcels are sorted into level catgories on a parcel-by-parcel basis. Domained.
ARTICLE_97	Yes/No. Is the parcel protected under article 97 of the Massachusetts Constitution? Domained. (EOEA use only).
EOEAINVOLV	Indicates the category of funding the parcel received from EOEA sources. Domained. (EOEA use only).
OS_DEED_BOOK	The number of the book the deed for this parcel and/or interest was recorded in at the local registry of deeds. Domained.
OS_DEED_PAGE	The starting page of the above recorded deed. Domained.
ASSESS_MAP	Tax map identifier text as determined by the Assessor
ASSESS_BLOCK	Tax map block identifier as determined by the Assessor
ASSESS_LOT	Tax map lot identifier as determined by the Assessor
ASSESS_SUBLOT	Tax map sublot identifier as determined by the Assessor
BASE_MAP	Number of the MassGIS basemap as indicated in the upper right corner of the map. This is the map data was recompiled upon. Only used for volunteer non-digital updating. (EOEA use only).
SOURCE_MAP	Code linking to the Source Map Worksheet delineating the specifications of the map that the polygon information was taken from.
SOURCE_TYPE	Text code indicating what the source data was to give a better estimation of the quality of the polygon attributes. This will be used for the entire polygon. For more specific source information on the arcs comprising the polygon, see the OPENSPACE_ARC feature class. Domained.
COMMENTS	No comment.
ATT_DATE	Date of last attribute edit.
FEESYM	Field used for symbolization of ownership (EOEA edits only).
INTSYM	Field used for symbolization of separated rights to OpenSpace land (EOEA edits only).
OS_ID	This is the unique statewide identifier taken from the coverage model. It has been changed from the old 7 digit integer where the first 3 digits (including leading zeroes) are the TOWN_ID number for the town the polygon exists in and the last 4 digits are the unique identifier for that town (formerly POLY_ID). As editing over

Field	New_type	Domain	Comments
TOWN_ID	SmallInteger - 3	Town_ID(2)	Range: 1 - 351
POLY_ID	LongInteger - 5		Limited to 99999 by definition
LOC_ID	String - 15		
FEE_OWNER	String - 100		Case independent?
ABRV_FEE_OWNER	String - 20		Coded off OSNAMES_MOD
TYPE_FEE_OWNER	String - 1	OS_Status	Coded
MANAGER	String - 100		Case independent?
ABRV_MANAGER	String - 20		Coded off OSNAMES_MOD
TYPE_MANAGER	String - 1	OS_Status	Coded
OTHER_1	String - 100		Case independent?
ABRV_OTHER_1	String - 20		Coded off OSNAMES_MOD
INT'_1	String - 20	OS_Interests	Coded
TYPE_1	String - 1	OS_Status	Coded
SITE_NAME	String - 120		
GIS_ACRES	Double - 10,4		Calc'd field
ASSESS_ACRES	Double - 10,4		
DEED_ACRES	Double - 10,4		
PROJ_ID1	String - 20		
CAL_DATE_REC	Date		Use Jan. 1 if only year is known
PRIMARY_PURP	String - 1	OS_Prim_Purp	Coded
PUB_ACCESS	String - 1	OS_Pub_Acc	Coded
CH61_PROG	String - 1	OS_Chap61	Coded
DOR_CODE	SmallInteger - 3	OS_DOR_types	Coded
OS_DEED_BOOK	LongInteger - 6		
OS_DEED_PAGE	LongInteger - 4		
ASSESS_MAP	String - 10		
ASSESS_BLOCK	String - 10		
ASSESS_LOT'	String - 10		
ASSESS_SUBLOT'	String - 10		
BASE_MAP	String - 10		Derelict field
SOURCE_MAP	String - 50		
SOURCE_TYPE	String - 10	OS_Source	Coded
COMMENTS	String - 255		
ATT'_DATE	Date		Calc'd field
CH61_ID	String - 9	Unique ID!	Calc'd field

CHAPTER61_POLY schema

the years has produced many various POLY_ID values, it was necessary to bump POLY_ID to a 5 digit integer. This has forced OS_ID to be altered to a 9 character string field. The first 3 characters are the TOWN_ID as before immediately followed by a dash. The last 5 characters are the POLY_ID. This archaic structure is a relic from the early coverage days of OpenSpace, but is retained as it links tens of thousands of pages of source documentation to the database. This field populated by the DBA.

GISDATA.CHAPTER61_POLY

Parcels participating in the Chapter 61 tax relief program have been mapped in OpenSpace since 1994. As participation in the program is determined by the local assessor, it is not homogeneously distributed through the state. Also, due to the limited term of the program, much of our data is out-of-date. For this reason the Chapter 61 data is being moved to a separate but topologically related feature class. Some assumptions can be made about Chapter 61 property that allow the attributes to be truncated relative to OPENSPACE_POLY, but distinct enough to preclude the use of a subclass. The table to the left is a brief description of all the feature class attribute fields. Following is a description of those fields not already described above.

CH61_PROG	The class of Chapter 61 program the parcel participates in. These are Chapter 61 (Forestry), 61a (Agriculture) and 61b (Recreation).
DOR_CODE	Use Code used by assessors as defined by DOR
CH61_ID	Unique ID for the feature class. Not necessarily distinct from OS_ID.

GISDATA.OPENSPACE_ARC

Every polygon in the OPENSPACE Feature Dataset (OPENSPACE & CHAPTER61) will have a boundary covered by OPENSPACE_ARC. The arcs will contain more information that they have previously. The old POLY_DATE field is now stored in the arcs due to the piece-meal editing/ updating of many parcels. We need to retain what portion of a parcel was edited when and with what source data.

Field	New_type	Domain	Comments
CODE	SmallInteger - 2	OS_Arcs	Coded
DROPLINE	String - 10	OS_Dropline	Coded
SOURCE_TYPE	String - 10	OS_Source_Type	Coded
ARC_DATE	Date		Formerly POLY-DATE from PAT, Calc'd
COMMENTS	String - 100		
ARCSYM	String - 2	OS_ArcSym	Coded

OPENSPACE_ARC schema

Akin to the ArcEdit coverage edit model, we can take points and arcs and create polygons (explicitly avoiding the term 'Build'). Also, for ArcView 3x editors, we can also create arcs from polygons using Map Topology (different from coverage topology and rules-based topology!). With these caveats and a detailed custom edit form, we can enforce a topological rule between OPENSPACE_ARC and the two polygon feature classes that all polys must be bounded by arcs. More detail on this process is in the OpenSpace SDE Editing Manual.

The Arc feature class has fields as follows:

CODE	This is the old code field from LIBRARIAN that links OS features to physical features
DROP_LINE	Code to enable site mapping by not drawing the internal arcs.
SOURCE_TYPE	Text code indicating what the source data was to give a better estimation of the quality of an individual arc. For use when a polygon is comprised of arcs from sundry sources. Domained.
ARC_DATE	Date of last spatial revision to arc in question. Assumes role of POLY_DATE.
COMMENTS	No comment.
ARCSYM	Code for drawing only arcs coincident with OS, CH61, or both.

GISDATA.OPENSPACE_TOPOLOGY

The rules-based GeoDatabase topology appears as a feature class in the Open Space Feature Dataset. Unlike coverage topology, the GeoDatabase topology allows for errors to persist without affecting the rest of the database. The rules used are defined as follows:

I.	OPENSPACE_ARC	Must not Overlap	
II.	OPENSPACE_ARC	Must not Have Dangles	
III.	OPENSPACE_ARC	Must be Single Part	
IV.	OPENSPACE_ARC	Must not Self-Overlap	
V.	OPENSPACE_POLY	Must not Overlap	
VI.	OPENSPACE_POLY	Boundary Must be Covered by	OPENSPACE_ARC
VII.	OPENSPACE_POLY	Must not Overlap	CHAPTER61_POLY
VIII.	CHAPTER61_POLY	Must not Overlap	
IX.	CHAPTER61_POLY	Boundary Must be Covered by	OPENSPACE_ARC

This set of rules approximates coverage topology. The editing tools of ArcGIS allow for the editor to create polygons from arcs or create arcs from polygons – this allows the editor to use whichever method they prefer for creating new features. They then use the automated tools to create the associated features required by the topology.

Epilogue

That's the general idea behind the new OpenSpace data model—Phase I at least. Now, how do you use it? Well, that is a topic for an entire other paper (*Costello*, 2004). Be sure to check out the OpenSpace Website which is being revised to match the release of the new OpenSpace data model. A new feature on the website will be an interactive status map allowing the user to query OpenSpace by town to find the date of the last arc +/or attribute updates. Welcome to the new OpenSpace!

Stay tuned for the release of Phase II.

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